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Recruiting Effects of Army Advertising

James N. Dertouzos, J. Michael Polich
with Anil Bamezai, Thomas Chesnutt

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This report analyzes the effects of Army advertising on recruiting. It uses an econometric analysis of information describing advertising patterns for the three-year period from 1981 to 1984. A model that controls for economic conditions, local area characteristics, the magnitude and direction of recruiter effort, and levels of other recruiting resources permits identification of the independent effects of different advertising purchases on the short-run supply of high-quality enlistments in the Army. The results show that, in general, advertising expenditures in a given month have a significant and immediate effect on the number of high-quality enlistments in the Army. Moreover, the advertising increases enlistments for as long as six months. The effects imply that the Army's national and local advertising programs compare favorably with other recruiting tools in terms of cost per high-quality enlistee. (SDW)

PREFACE

This report analyzes the effects of Army advertising on recruiting. Utilizing unique information describing advertising patterns for a three-year period from 1981 to 1984, the research extends previous studies of recruiting resources. The report provides quantitative estimates of the relative effectiveness, in the short run, of different categories of media expenditures in producing enlistments in the Army. These results should be of use to service advertising managers in allocating their budgets, policymakers concerned with the relative effectiveness of alternative recruiting resources, and individuals with a general interest in the relative influence of media purchases.

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SUMMARY

Advertising is one of the central recruiting tools used by the U.S. Army to achieve its enlistment goals. In recent years, the Army's expenditures for enlistment advertising in major media have totaled \$40 to \$45 million annually, about two-thirds of the amount spent by all the military services on service-specific advertising. Despite the importance of recruiting advertising, little research on it has emerged. Few studies differentiate among the broadcasting and print media for national advertising, and there is no published research on local advertising at all.

Research reported here uses an econometric analysis of unique information documenting monthly Army advertising expenditures for a three-year period between 1981 and 1984. A model that controls for economic conditions, local area characteristics, the magnitude and direction of recruiter effort, and levels of other recruiting resources permitted identification of the independent effects of different advertising purchases on the short-run supply of high-quality enlistees to the Army.¹

The empirical results show that, in general, advertising expenditures in a given month have a significant and immediate effect on the number of high-quality enlistments in the Army. Moreover, the advertising has a lagged effect, increasing enlistments for as long as six months, although the effect dampens out over time. The enlistment effect of advertising in a given month falls by about 42 percent each month after the advertising appears.²

The effects found in this analysis imply that the Army's national and local advertising programs compare favorably with other recruiting tools in terms of cost per high-quality enlistee. For example, considering the mix of media the Army employed during the study period, we estimated the marginal cost of recruiting a high-quality person through increased advertising to be between \$5,000 and \$6,000. The marginal

¹High-quality enlistees, as defined by the Army, are those who have a high school diploma and score at the 50th percentile or above on the Armed Forces Qualification Test (AFQT).

²For example, suppose a given change in advertising increases enlistments by 2 percent in the same month. In the next month, enlistments will continue to be higher than they otherwise would have been, by 1.3 percent ($2.0 \times .58$), even if the advertising returns to its original level. In the second month, the effect is 0.7 percent ($2.0 \times .58 \times .58$), and so forth. After six months, the original effect will have shrunk to 4 percent of its original level.

cost of achieving the same goal by increasing the recruiting staff was about \$5,700, and the cost of using cash bonuses was much higher (about \$16,000 per recruit).

In addition, the various types of media differ substantially in cost effectiveness. In particular, national magazine and local newspaper advertising are the most cost effective in promoting short-run enlistment responses, costing between \$2,000 and \$3,400 per additional recruit. National broadcasting purchases, both network television and radio, also have strong effects but, at least over the range of our observations, appear to cost somewhat more than the print media (\$7,000 to \$10,000 per marginal recruit).³ At the other extreme, local radio has no detectable effect on short-run enlistments. Local radio averages about one-half of the local advertising budget, so some reevaluation of this program is in order. Finally, for all other forms of local advertising, including high school publications and weekly newspapers, estimated coefficients were not statistically different from zero. However, unlike the estimate for local radio, these estimates were not sufficiently precise to support policy conclusions.

Despite the importance of the results for efficient management of the Army advertising budget, the study has several limitations that policymakers should consider in setting policy and research priorities. Although advertising expenditures can have major effects on Army enlistments, other effects are also possible. For example, advertising could have a long-run influence on public perceptions of the military and on service members' own morale and reenlistment behavior. This study could not examine such phenomena. Changes in Army advertising may also affect the other services. From a DoD perspective, it would be valuable to know whether the increased Army enlistments derived from a rise in Army advertising are taken from the civilian sector or are merely drawn from the Navy, Marine Corps, or Air Force. Although our data did not permit examination of such effects, these issues merit consideration in future research.

³These figures are point estimates; the 95 percent confidence limits imply a variation between about \$1,000 and \$5,000 for the print media, and between \$5,000 and \$16,000 for the broadcast media.

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Ani Haigazian provided valuable research support and managed the process of accumulating the extensive data files required for this project. Joanna Campbell provided excellent secretarial assistance. Useful technical reviews and comments were given by Charles Brown, University of Michigan, and RAND colleague Bridger Mitchell.

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I. INTRODUCTION

Advertising is one of the primary tools used by the Department of Defense (DoD) and the military services to meet recruiting goals. In recent years, the Department of Defense has spent between \$15 and \$20 million per year in major media purchases for its Joint Recruiting Advertising Program, while the individual services spent about \$65 million on their own programs.¹ Of the latter, the Army's program is by far the largest, representing about two-thirds of the individual services' total. This reflects both the size of the Army's recruiting requirements (about half of all DoD accessions) and the fact that historically the Army has experienced greater difficulties than the other services in securing its desired level of qualified recruits.

Most recruiting advertising is done through national or centralized media purchases: network television, network radio, national magazines, and direct mail. The services typically use these media to disseminate messages intended to enhance their image and to describe the general character of the jobs and training they offer. In addition, each service carries out a local advertising program, through which local districts promote more immediate themes—such as current job opportunities, enlistment options, and the names and telephone numbers of recruiters who can be contacted by prospective recruits. Local advertising is also cited as a means of supplementing the national campaigns, especially in areas not penetrated as extensively by major electronic media. In all, local advertising accounts for about 10 to 15 percent of the Army's total advertising budget, or about \$4–6 million annually.²

The purpose of this study is to gauge the effectiveness of the various forms of Army advertising. As our review of the general literature will show, there are many uncertainties concerning the effects of

¹These figures refer to the direct purchases of media resources (time or space) in Fiscal Years (FY) 1982 through 1984, the time period of the study. For example, in FY84 the Army spent about \$36 million on enlisted program advertising in national media, \$6 million in local and regional media, and \$0.6 million on direct mail, for a total of \$43 million. The other services spent a total of \$22 million, and the Joint program spent \$19 million. Figures for the preceding two years were very similar. Official budget totals for advertising accounts are about 60 percent higher because they include numerous non-media items, such as lead fulfillment, sales promotion, market research, printed brochures, and special programs for reenlistment, officer recruiting, and medical recruiting.

²This dollar value does not include measures of free advertising time that is frequently donated by media firms as a public service. Although potentially important, no data exist to consider these forms of advertising.

advertising on private sector markets when firms attempt to influence consumers' purchasing decisions. When it comes to research on advertising for recruiting, the dearth of information is even more pronounced. Few studies differentiate among the various electronic and print media, and there are no published studies of local advertising at all.

This research begins to fill the gap, extending previous analysis of enlistments by adding unique data describing the patterns and distribution of Army advertising expenditures between 1981 and 1984.³ The specific aims of the research are threefold:

1. To describe media purchases, analyze patterns in audience delivery, and examine budget allocations by area, time period, and type of medium;
2. To relate advertising resources to the supply of enlistees, particularly "high-quality" enlistees as defined by the military services;⁴
3. To draw inferences about the relative efficiency of advertising expenditures that can aid in the optimal allocation of resources across types of media.

The current study does not address several important issues that a comprehensive evaluation of service advertising should address. First, we consider only the short-run effects of advertising on Army enlistments. Given data limitations, we can not analyze whether increased Army enlistments are attracted from the civilian sector or are drawn from the other services. Furthermore, the effects of potential long-run benefits and costs of advertising on morale and personnel attrition and retention, or broad political benefits, are beyond the scope of this work.

Section II briefly reviews the general literature on advertising effectiveness, outlines the most important issues, and draws implications for the analysis of military advertising. Section III describes the advertising database and presents patterns of expenditures as well as the delivery of audiences by medium. Section IV reports our econometric analysis of the short-run enlistment effects of advertising on the number of young men recruited into the Army. Finally, Section V discusses implications of the research for military recruiting policy.

³This advertising information supplements data described and analyzed in Polich, Dertouzos, and Press (1986).

⁴A "high-quality" enlistee, in the Army's definition, is one who has a high school diploma and a score at the 50th percentile or higher on the Armed Forces Qualification Test. DoD and service studies have shown that such persons are more likely to remain in the service through their term of commitment, to avoid disciplinary problems, and to perform satisfactorily on the job (Office of the Assistant Secretary of Defense, 1985).

II. ESTIMATING ADVERTISING EFFECTIVENESS: GENERAL ISSUES

Although the services' long-run marketing goals differ from private business objectives of profit maximization, the evaluation of advertising effectiveness can be based on similar criteria. Because methodological issues that are prominent in the general literature on advertising parallel those found in research on military enlistment supply, we summarize the most important general research issues before turning to a discussion of previous studies of service advertising. Not surprisingly, we find that many of the modeling and data deficiencies in civilian studies also complicate evaluations of military advertising.

ADVERTISING POLICY ISSUES

Establishing an effective allocation of resources means that policy-makers must address a series of central questions concerning the goals and methods of advertising programs. A manager needs to identify a target audience, establish a budget, allocate dollars among alternative media, and implement an optimal pattern of expenditures over time.¹

Advertising Objectives

Of course, the optimal allocation of expenditures over time and across media depends on the objectives of advertising, which may vary in different circumstances. In the case of recruiting advertising, the current accession situation may imply a particular strategy. During an economic downturn, enlistment propensities may be adequate even in the absence of advertising. In such a recruiting environment, an appropriate campaign might emphasize building a firm foundation for future enlistments through aiming at a younger target population. In contrast, an unexpected shortage of accessions into critical occupational specialties might make the most appropriate campaign a series of advertisements in local newspapers or high school publications emphasizing enlistment bonuses or educational benefits, which are limited to particular specialties.

¹In addition, managers must make important decisions concerning the "creative" content of advertising. Given data limitations, it was not possible to consider the influence of alternative advertising messages, themes, or creative impressions.

Our interest lies in examining effects of advertising on the production of new Army recruits, particularly "high-quality" enlistees, who are always in short supply relative to the services' preferences. However, military managers may have other goals in mind for advertising. For instance, the Army Recruiting Command may wish to enhance equity across recruiting districts by equalizing the difficulty for all recruiters in achieving their recruiting goals or "missions." As an example, a network television advertisement might not penetrate remote markets. Through local advertising, this apparent handicap facing recruiters who operate in isolated markets can be mitigated. If the "equalization" objective were deemed appropriate, such a pattern of spending might be desirable even if the aggregate number of enlistments could be increased by a different scheme.

Similarly, Department of Defense managers, like managers of private corporations, may wish to enhance the image or standing of their organization in the public mind over the long term, assuming that such enhancement will ultimately improve the climate for recruiting and retaining not only enlisted personnel but also officers and even civilian employees of the Defense Department. Many observers, for example, have noted an overall improvement in the Army's image among American youth during the past 10 years (Bray, 1985), and it is reasonable to assume that the trend is paralleled among the general public; some observers attribute that improvement, in part, to the Army's image-related television advertising. Our data cannot address the effectiveness of advertising in achieving such long-term goals. We limited the scope of our analysis to the short-term effects of advertising on recruiting, although the long-term image effects of advertising may be important considerations in policymaking.²

Budget Levels and Allocation Among Media

From the advertising manager's perspective, the size of the advertising budget may be viewed as being fixed in the short run. However, for the organization as a whole, advertising represents one type of resource that must compete with alternative expenditures. If the primary goal is to maximize enlistments subject to overall budget constraints, resources should be allocated so that the marginal increase in recruits per dollar cost is equalized for all expenditure categories, including advertising programs, educational benefits, enlistment bonuses, recruit-

²If the long-term goals are important, then the absence of any measurable enlistment effects is not a sufficient justification to reduce advertising expenditures.

ing personnel, and first-term salary schedules.³ Of course, such factors as the timing of enlistment effects, the different military occupational choices, attrition and retention response of individuals drawn by various programs, and the broader effects on political attitudes and service morale complicate the analysis.

When given an overall budget, managers must then evaluate the many competing media that could be used to deliver messages to the target audience. Clearly, advertising purchases can differ in several ways. Similar expenditures may vary by the size and demographics of the audience reached, relative penetration of the target market, and the cost of delivery. In addition, alternative media may have comparative advantages in conveying qualitatively different messages. For example, electronic media such as prime-time network television are likely to be more efficient at exposing heterogeneous national audiences to messages that convey broad images; but a display advertisement in a high school newspaper can provide detailed information to a distinct demographic segment of the population. Depending on the objectives of advertising, each medium could play a role. In principle, decisions about media mix should be governed by an understanding of the marginal increase in some objective criterion (e.g., number of high-quality recruits) that will be affected by the various combinations of media.

Pattern of Advertising

According to marketing practitioners, the pattern and timing of an advertising campaign can also be quite important in achieving maximum productivity from a fixed budget. The effect of staggered bursts of intense advertising might be quite different from that of a continuous flow of messages. Media productivity is probably enhanced by appropriate combinations of advertising expenditures. For example, the national electronic media could be used to convey an image and provoke an awareness or interest in military service as a viable option. Print advertising could then "close the sale" by providing more facts to potential enlistees who are motivated to search for and gather further information.⁴

³This assumes that the marginal recruits attracted by different programs are homogeneous. This is a very strong assumption. For example, it is likely that individuals drawn to the Army by educational benefits have higher aptitude, lower attrition, and lower reenlistment rates than other individuals.

⁴For a discussion of such synergies, see Lieberman (1985).

ADVERTISING EFFECTIVENESS: GENERAL KNOWLEDGE

The marketing literature contains countless studies attempting to quantify the effect of advertising on the sales of consumer products. However, despite a vast literature, no strong consensus has emerged. As one observer noted: "There is barely a molehill of hard evidence behind the mountain of prose on the subject of advertising."⁵ In large part, this lack of consensus is unsurprising. After all, advertised products differ dramatically in terms of the underlying consumption attributes, marketing network, and competitive structure. Furthermore, advertising effectiveness will depend on the creative and informational content of the delivered message. Perhaps most important, previous analyses of advertising are hampered by three general problems: potential nonlinearities in consumer responses, substantial leads and lags in the advertising-sales relationship, and the absence of refined data.

Sales Responses to Advertising

Although evidence is hardly conclusive, most studies acknowledge that the relationship between advertising and sales is quite complex. For example, several researchers suggest that there may be a threshold or minimum level of advertising necessary to induce increases in sales.⁶ Beyond this threshold point, sales continue to rise with advertising, but eventually diminishing returns are thought to dominate.⁷ A saturation point can occur, with increases in advertising producing little or no effect on sales. The result of having threshold as well as saturation effects implies an "S-shaped" advertising response curve.⁸ Such response relationships are not typically captured by the functional forms utilized in most empirical research.⁹ To the extent that expenditures do not have wide variation, the assumption of constant elasticity over the relevant range may not be terribly damaging. However, one

⁵See Schmalensee (1972).

⁶For evidence of this phenomenon, see Benmaor (1984), Rao (1970), Rao and Miller (1975), or Wittink (1977), among others.

⁷For some early experimental results, see Benjamin and Maitland (1958). A more recent discussion and econometric evidence are presented by Hirschey (1982).

⁸For a discussion of the underlying theory, see Arndt and Simon (1980) and Parsons (1981). It can be argued that the S-shaped response curves are useful for describing individual behavior but, in summing over groups of heterogeneous consumers, are less relevant for aggregate market characterizations.

⁹Most empirical research specifies a "log-linear" relationship between advertising and sales. For an alternative specification that is flexible enough to accommodate both effects simultaneously, see Johansson (1979).

must be very cautious in generalizing the results far beyond the observable levels. Given an S-shaped response curve, the absence of a discernible effect could be consistent with an advertising budget that is either too big or too small.

The Dynamics of Advertising and Sales

Causal relationships between sales and advertising are complex and dynamic, further hampering precise empirical identification. For example, firms often allocate advertising budgets as a fixed percentage of previous sales. This "rule-of-thumb" practice makes it quite difficult to separate cause from effect. Although simultaneous equation remedies do exist, the methodologies depend on making very restrictive assumptions concerning the underlying structure of causation.¹⁰

The process is further complicated by the fact that the effect of advertising may be cumulative, taking place over a long period of time. Particularly for the case of products that are not purchased frequently, the effect of advertising will not be observed until consumers arrive at a decision point. Impressions are established and information is gathered for several periods before any action is taken. Clearly, models that consider only contemporaneous effects without considering future response are of limited use in quantifying the sales-advertising relationship.¹¹

Marketing studies examine additional response phenomena, suggesting that examining steady-state levels of advertising and sales may not be appropriate. Changes in advertising may be more relevant than uniform levels of expenditures. Sales increase immediately following a rise in advertising expenditures but often diminish subsequently, even if expenditures are held constant at the new level. However, the evidence fails to disentangle the confounding effects of advertising expenditure fluctuations and changes in the "copy" or message of a campaign. Expenditure increases are generally correlated with fresh advertising efforts while constant levels may or may not indicate messages that have become stale or overused.¹²

Finally, additional modeling challenges are posed by an apparent asymmetry in the response of sales to increases and decreases in

¹⁰For discussion of econometric issues related to the simultaneity of sales and advertising, see Bass and Parsons (1969), Helmer and Johansson (1977), Heyse and Wei (1985), and Moriarty (1983, 1985) among others.

¹¹Applications of statistical methodology in determining the structure of distributed lags in response to advertising expenditures can be found in Bass and Clarke (1972), Box and Haugh (1977), Clarke (1976), and Erickson (1981).

¹²For further discussion of these issues, see Ackoff and Emshoff (1975), and Bloom, Jay, and Twyman (1977).

advertising expenditures. Advertising increases can produce delayed increases in sales. A rise in the level of advertising may not instantaneously boost sales but will produce a gradual increase to a new steady-state level that later declines. In contrast, advertising effects are often thought to "decay" slowly—that is, the positive effect of the more intense advertising effort will persist for some time even if expenditures fall to the previous level. Marketing research indicates, although not convincingly, that this rate of sales decay is considerably lower than the initial growth rate.¹³

Data Limitations

Theoretical models of optimal advertising behavior have for some time included many of the complexities of response described in the marketing literature.¹⁴ However, there is still a dearth of reliable empirical evidence concerning these relationships. In practice, the main obstacle to analyzing the complexities that are suggested by marketing surveys and formalized in theoretical models has been the absence of detailed data. In general, empirical researchers analyze annual advertising expenditures for firms in broad industry categories. For example, a study may examine annual levels of total advertising expenditure by the automobile industry, the drug industry, or others as predictors of the sales volume.¹⁵ Although not all studies are equivalently affected, the available data usually limit the analyses for several reasons.

First, most aggregate advertising studies do not adequately control for nonadvertising factors that may affect sales. Certainly, statistical comparisons across broad industry categories do not account for dramatic structural differences between firms in the same industry. Patterns in sales levels for individual firms can be affected by product characteristics, technological change, cyclical demand fluctuations, market structure, and management philosophy. Such interindustry differences may be confounded with, or may interact with, variations in the level of advertising.

Advertising data are often reported on an annual basis only. Because responses to advertising are believed to be governed by cycles completed within a few months, annual budget levels do not permit an

¹³An example of this literature is Haley (1978). For a review and description of several other studies, see the discussion in Little (1979).

¹⁴The most often cited of these include Mann (1975), Nerlove and Arrow (1962), and Vidale and Wolfe (1957).

¹⁵Not surprisingly, no strong conclusions emerge from these aggregate studies. For a summary and meta-analysis of this literature, see Assmus, Farley, and Lehmann (1984).

analysis of advertising patterns and the short-term dynamic effect on sales.¹⁶ More frequent observations are preferable because even if annual advertising budgets do not vary much from year to year, actual expenditures can fluctuate unsystematically during short time periods. In addition, the shorter the time period, the lower the correlation between current advertising expenditures and the volume of past sales that may have determined the level of the annual budget.

Available measures of advertising expenditures do not typically distinguish among alternative media purchases. As suggested earlier, the efficient allocation of advertising expenditures depends on some knowledge concerning the relative effectiveness of the various media. Unfortunately, such disaggregated information is seldom available for analysis and this major issue cannot be addressed.¹⁷ In addition, if advertising budgets are determined on the basis of rather rigid rules of thumb, the sales, advertising budgets, and expenditures on other marketing efforts will tend to vary together over time. The resulting high correlations among variables inhibit precise estimation of relevant coefficients. Also, total advertising budgets may not vary enough to evaluate a wide range of expenditure levels. However, if media allocations change, the disaggregated data exhibit more pronounced variation, thereby facilitating analysis of more extreme policy options.

RESEARCH ON RECRUITING ADVERTISING

Since the inception of the all-volunteer armed forces, numerous studies have attempted to quantify the importance of economic factors, marketing resource expenditures, and enlistment incentives on the supply of military recruits. Typically, studies conclude that advertising allocations are not as important as other factors in the determination of enlistment supply.¹⁸ This result is consistent with econometric results found more generally.¹⁹ After all, despite apparent differences in institutions and management philosophies, the methodological issues

¹⁶See Montgomery and Silk (1972).

¹⁷If the main research interest involves computing the contribution of the marginal advertising dollar, this aggregation is reasonable under certain conditions. In particular, if one is willing to assume that advertising dollars are allocated efficiently, then the marginal productivities will be equalized across different media. We believe, however, that it would be far better to test for this equalization than treat it as an assumption.

¹⁸Because of their focus on advertising effects, several studies conducted for the U.S. Navy are of particular interest. See Bayus et al. (1985), Goldberg (1982), Hanssens and Levien (1983), and Morey and McCann (1980).

¹⁹For example, Lambin (1976) concludes that "the impact of advertising is modest in comparison with that of environmental factors and other market variables."

are the same for estimating advertising effectiveness in the civilian and military sectors. Thus, recruiting advertising research is similarly marred by weak data, model inflexibility, and econometric techniques that fail to incorporate important aspects of the enlistment process.

For example, past estimates of advertising effectiveness may have been affected by a failure to consider the potentially important role of recruiter behavior in the determination of enlistments. As is well known, the quantity and quality of enlistments can be substantially affected by quotas and recruiter incentives to achieve and exceed them. Suppose, for example, that an effective television campaign increases the propensity of high school seniors to enlist. However, if recruiters have no incentives to exceed their missions or quotas, the number of enlistments may not increase significantly. In effect, the advertising altered the effort required by recruiters to meet their mission. However, the enlistment outcome would not appear different.²⁰ Thus, an accurate estimate of advertising effectiveness should employ an estimation methodology that explicitly considers the role of these factors.

Finally, modeling and methodological problems of recruiting research also parallel those present in the general marketing literature. Estimated models are overly restrictive and do not permit analysis of the variety of phenomena described in theoretical research. For example, few studies consider the lagged effects of advertising expenditures. To the extent that advertising has enlistment effects that are more persistent than other resource expenditures, the resulting comparisons are likely to misrepresent their relative effectiveness.

²⁰See Polich, Dertouzos, and Press (1986) for a more detailed discussion of such factors. Hanssens and Levien (1983) present some evidence that indirectly illustrates the importance of recruiter behavior. Their estimate of enlistment effects for local advertising expenditures is insignificantly different from zero. Thus, they argue that such expenditures are ineffective. However, to test for robustness, they split the sample into two groups defined on the basis of the average productivity of Navy recruiting districts. For those districts typically meeting their missions, the effect of local advertising was insignificant. In contrast, estimates for the low productivity districts that typically do not achieve quotas suggested that local advertising effects were positive and significant.

III. MEASURING ADVERTISING

Previous efforts at quantifying the effects of advertising, both generally and for the military, have not been fully satisfactory. One of the most serious problems contributing to this situation has been the lack of systematic and detailed measures of the actual distribution of advertising across areas and periods of time. To overcome such problems, we constructed a comprehensive database that described monthly advertising expenditures in Army recruiting areas and linked those expenditures to audience figures. This section describes the expenditure data, details the methodology used to derive audience estimates, and discusses some patterns in the relationship between expenditures and market penetration.

OVERVIEW OF THE ADVERTISING DATA

Monthly advertising data were compiled for a three-year period, from July 1981 through June 1984. Observations described advertising within each of 66 areas as defined by the boundaries of the Department of Defense Military Entrance Processing Stations (MEPS). DoD collects a large number of data items routinely for these areas, which are defined along county lines.¹ In total, a database having considerable detail was available for analysis (2,376 observations = 66 areas \times 36 months). As a result, many of the problems that have plagued previous studies, which have often worked with annual observations or large areas, were avoidable.

The data were collected by medium for both national and local expenditures. National advertising included ads on both television and radio, network and nationally purchased spot ads, as well as national magazine ads. Local advertising included daily, weekly, and high school newspapers and locally purchased spot radio ads. Finally, data

¹In principle, the area of measurement for advertising could have been even more disaggregated. The national advertising data were provided at the level of 210 advertising market areas known as Areas of Dominant Influence or ADIs, which are constructed so that each county in the United States is assigned exclusively to the market whose local television stations dominate viewing in that county. Although local advertising measures could have been constructed by ADI, it would have been much more difficult to obtain reliable measures of other explanatory variables (particularly unemployment rates, numbers of recruiters, and recruiting quotas) at the ADI level of disaggregation. Also, because DoD had already made a considerable investment in securing such measures for MEPS areas, retaining MEPS as the basic geographic unit seemed prudent.

were gathered on "nonstandard media," including miscellaneous categories such as booths at state fairs, materials for "career" days at high schools, ads in sports programs, and outdoor advertising.

MEASUREMENT OF ADVERTISING VARIABLES

Assessment of advertising phenomena is inherently more complex than, say, counting enlistments or other localized phenomena, because advertising space or time is purchased centrally from the media but achieves its effects by disseminating information across areas. Consider, for example, a purchase of national television advertising. A spot placed on a network has a defined cost, but the cost covers all impressions it creates nationwide.² Because the advertising penetrates different communities unevenly, it is often argued that one should estimate the degree of "advertising delivery" in each local area. To determine how important such delivery data might be, we used several methods to estimate advertising audiences.

National Advertising. During the study period, all of the Army's national advertising was placed by N. W. Ayer, Inc. At the Army's request, Ayer provided estimates of the number of impressions generated each month by its advertising on television, on radio, and in national magazines, for each of the 210 ADIs.³ The total dollar value of expenditures nationwide was also provided for each medium by month. For each month and each medium, we allocated total national expenditures among ADIs in proportion to each ADI's number of impressions. We then aggregated the ADI totals to MEPS areas.⁴ Because national purchases exhibit considerable differences in audience penetration over time and between areas, these local measures are truly independent observations.

Local Advertising. To measure local Army advertising, Ayer provided records of all purchase orders issued by local Army recruiting

²An impression is defined as an exposure of one individual to one ad. Thus, the number of impressions for a given advertising buy is estimated by multiplying the number of times the ad is run (frequency) by the number of individuals who see the ad (audience size).

³Such estimates of audiences are based on large-scale surveys of the population to determine the number of persons who watch or listen to broadcast stations and the number who read the print media. The Ayer estimation method for national media, like our own method for local media (see the appendix), relied on identifying the specific media outlets that carried each advertising message and matching the outlet to the audience for that outlet.

⁴The allocations were done by disaggregating the reporting areas (such as ADIs) into segments (such as counties) whose boundaries corresponded to those of MEPS areas, apportioning reported totals to segments in proportion to 1980 Census populations where necessary. The segments were then recombined into MEPS area clusters using population figures as weights where appropriate.

battalions during the 36-month study period.⁵ Generally, Army local advertising concentrates on four types of media: daily newspapers, other commercial newspapers (largely weeklies), high school newspapers, and individual radio stations. About 80 percent of the Army's local media expenditures is directed to one of these media. The remaining 20 percent goes to other vendors, termed "nonstandard" media.

The purchase records were used to create two alternative measures of advertising delivery: costs and impressions. Costs were estimated simply by aggregating the value of the purchase orders by medium by battalion; battalion totals were then converted to MEPS area estimates. Impressions were estimated by identifying the specific individual newspaper, radio station, or other vendor that carried each ad, and multiplying the ad frequency by the average size of the audience for that vendor.⁶ Radio audiences were determined from the Arbitron Ratings Company's county-level survey data. Commercial newspaper audiences were determined from county-level circulation figures from *Circulation '83/'84*, the N. W. Ayer Directory of Publications, and the 1984 *National Directory of Weekly Newspapers*. High school newspaper circulations were estimated from Department of Education and Army data indicating the enrollment of seniors at specific high schools.

GENERAL PATTERNS IN ADVERTISING EXPENDITURES

Table 1 describes a typical MEPS advertising pattern for a single month. On average, allocated national advertising expenditures are slightly more than \$24,000. Of this total, television advertising dominates, accounting for nearly 70 percent. Network radio buys amount to 18 and magazine buys to 13 percent. Local advertising budgets, in contrast, are one-fifth as large, averaging \$4,479 monthly.⁷ Spot advertising on radio stations is the most important category of local media purchases. On average, \$2,541, or 57 percent, was spent on local

⁵Army recruiting battalions are local districts (54 in total nationwide), roughly the same size as MEPS areas.

⁶For example, an order for five insertions in a local daily newspaper with a circulation of 50,000 households would result in an estimate of 250,000 daily newspaper impressions; an order for 10 spots on a radio station with an audience of 20,000 would result in an estimate of 200,000 radio impressions. Of course, impressions are not comparable across media, especially as they are only proxies for actual exposure. For details of the impressions estimation process, see the appendix.

⁷In the following analysis we have omitted nonstandard media. As suggested earlier, these expenditures are impossible to rate in terms of audience delivery. In addition, the inclusion of variables meant to capture the possible enlistment effects of nonstandard media dollar expenditures were invariably insignificant.

radio. Expenditures on daily newspaper display and classified ads were typically 27 percent of the total. Advertising buys in high school publications and weekly newspapers each averaged under \$400 monthly, or 8 percent.

In general, there is significant variation in both the levels and mix of expenditures for local and national advertising. This variation exists both over time and across individual MEPS areas. National advertising dollars are centrally allocated among media, but the mix of media purchases varies over time. Because these alternative media purchases do not penetrate all markets equally, there is significant variation in the allocation of national ad dollars to the different markets.

As reported in Table 2, for example, monthly averages for individual MEPS exhibit significant variation. Over the three-year period, the average total national advertising budget allocated to television ranged from 47 to 73 percent. For some MEPS, the allocation of magazine advertising dollars amounted to as little as 9 percent of the total. For others, the allocation was three times higher or 27 percent.⁸

For local advertising, expenditure levels vary significantly from month to month, partially because of different quarterly budget

Table 1
AVERAGE MONTHLY ADVERTISING EXPENDITURES,
BY MEPS

Expenditures	MEPS Monthly Average	Percent
National		
Television	\$16,597	69
Network radio	4,367	18
Magazine	3,069	13
Total	\$24,033	100
Local		
Local radio	\$ 2,541	57
Daily newspapers	1,217	27
High school papers	369	8
Weekly newspapers	352	8
Total	\$ 4,479	100

⁸This conclusion was supported by regressions of the local advertising budgets, indexed by youth population measures, on the variables mentioned above.

Table 2

CROSS-SECTION VARIATIONS IN ADVERTISING
EXPENDITURES: MEPS MONTHLY AVERAGES
(Percent of budget)

Expenditures	Range of Monthly Averages	
	Minimum	Maximum
National		
Television	47	73
Network radio	15	31
Magazine	9	27
Local		
Local radio	14	82
Daily newspapers	9	60
Weekly newspapers	0	24

allocations. However, even after we control for cyclical variations in the total amount of money allocated and for fixed MEPS characteristics, local advertising budgets varied significantly across individual areas.⁹

To some extent, the unexplained variation stems from the considerable discretion that local advertising managers and individual media outlets have over the timing of these expenditures and audience delivery from month to month. Regardless of the source, the apparently unsystematic variation in the data strongly indicates that an empirical analysis of advertising effectiveness will not be hampered by the collinearity between variables that so often plagues research in this area.

The allocation of the local advertising budget among media alternatives also exhibits tremendous variation over time and between MEPS areas. For individual areas, monthly budget allocations for a specific medium often range all the way from 0 to 100 percent of the total. Some of these differences are persistent. For example, although the typical MEPS area exhibited average daily newspaper advertising of about 27 percent of the local advertising budget, mean expenditures

⁹To support this, we regressed total local advertising dollars per 1,000 male youths on monthly and local MEPS dummies (101 in all). Controlling for the overall budget level and systematic area differences in this way accounted for only 28 percent of the variance. On average, the independent variable was .56. The coefficients on dummy variables representing MEPS ranged between -.06 and .13. The time dummies ranged between a value of -.13 and .08.

(for a single MEPS, computed for the three-year period) ranged from 9 to 60 percent.

There do not appear to be important patterns in the choice of media mix. However, local advertising budget allocations among media are somewhat sensitive to relative prices as well as audience or market penetration. For example, scale economies in the production of newspaper circulation cause large differences in the cost of reaching a given audience size. We calculated the cost of placing a line of advertising in every local newspaper in each MEPS, based on data published in *Editor and Publisher International Yearbook*. Divided by the aggregate circulation (in thousands) of newspapers in the market, the milline price can be interpreted as the cost of reaching 1000 subscribers with a single line of advertising. Across MEPS, this price ranged from 1.1 to 2.6 cents. Also, daily newspaper advertising differs substantially in its ability to penetrate or blanket market populations. The ratio of aggregate daily circulation to total young male population within MEPS ranges from .32 to 1.05. Regression results suggest that local media buys are negatively related to prices and positively related to audience penetration.¹⁰ However, these factors explain only 2 percent of the variance in the month-to-month percentage of local advertising dollars allocated to daily newspapers. Again, this lack of strong correlations, either over time or across MEPS, in the allocation of advertising dollars will facilitate the statistical identification of separate media effects.

MEASURES OF MEDIA PENETRATION: COSTS VERSUS IMPRESSIONS

As illustrated in our example of varying newspaper milline costs, dollar expenditures on alternative outlets within a given medium are not equally effective in achieving penetration. The scale economies so evident in daily newspapers prevail for all print media. The intuition for this phenomenon is straightforward. The fixed cost of creating, composing, typesetting, and arranging an ad is independent of how many copies of the publication are printed. Given constant (or dimin-

¹⁰The regression results were as follows:

$$\begin{array}{l} \text{Log (Daily)} = - 1.650 + .093 \text{ Pen} - .142 \text{ Rate} \\ \quad \quad \quad (.118) \quad (.017) \quad \quad (.042) \end{array}$$

where Daily represents the percent of the total local advertising budget in a given month, Pen represents the ratio of daily circulation to male youth population, and Rate is the cost per 1000 subscribers within that MEPS. The R^2 in this regression was .018.

ishing) duplication costs, the average cost of an ad per unit of circulation will decline as audience increases.¹¹

An even stronger argument can be made concerning the cost of electronic advertising. An ad heard by 50,000 households costs no more to create and play than one heard by a single listener. As a result, large media outlets are generally more effective at converting dollars into impressions. Since large media outlets are generally located in large population centers, the cost of a television or radio ad varies substantially across different areas of the country, hence different MEPS. Advertising spots per unit of audience will cost less in markets served by stations having many listeners. The upshot for analyzing advertising effectiveness is that dollar measures may not accurately represent the degree of media penetration.¹²

To investigate this possibility, we compared local monthly advertising expenditures with aggregate local radio audiences and daily circulations of newspapers in which ads appeared.¹³ Regressions of impressions on dollar expenditures indicated very large and systematic differences between MEPS. For both local radio and daily newspaper advertising purchases, the average impressions per dollar could range by as much as a factor of three, which is entirely consistent with published advertising rate and audience data found in trade journals. However, after accounting for variations across areas, our analysis suggests that there is a one-to-one correspondence between changes in expenditures and changes in impressions as shown in Table 3.

These results also suggest a valuable method of simplifying research procedures. The figures indicate that, *once systematic differences across MEPS are taken into account*, cost data accurately reflect the penetration of advertising.¹⁴ In fact, cost data may be better because they are probably measured with substantially less error. Given the great difficulty, expense, and potential for error in gathering data, the simpler cost data are to be preferred. In what follows, we have used the cost data rather than audience or ratings data to represent advertising in specific media.

¹¹For evidence of scale economies in newspaper production, see Dertouzos and Thorpe (1982).

¹²As mentioned earlier, in addition to being a more accurate measure of audience penetration, "advertising impressions" are likely to exhibit more substantial and unsystematic variation over time and across geographic areas than are "advertising dollars." In general, this remains true, but, at least for Army allocations, we have seen that there is considerable variation in dollars, thereby relieving the collinearity problem likely to hamper other advertising studies.

¹³Recall that national ad purchases, made centrally, are then allocated to MEPS areas on the basis of impressions. Thus, the distinction between impressions and dollars is not relevant.

¹⁴For many applications, standardizing for such fixed effects may not be possible without sufficient time series and cross-section data.

Table 3

THE RELATIONSHIP BETWEEN LOCAL MEDIA
IMPRESSIONS AND EXPENDITURES^a

Dependent Variable	Impression/Cost Elasticity	Standard Error	R ²
Newspaper impressions	.898	.012	.804
Radio impressions	.966	.008	.926

^aVariables were defined in terms of log-differences to net out the systematic differences between MEPS and to eliminate effects of MEPS size.

IV. ECONOMETRIC ANALYSIS OF ENLISTMENT EFFECTS

The main purpose of this study is to examine the effects of various advertising expenditure patterns on the production of Army enlistments, particularly high-quality enlistments. We first explain the basic econometric approach that we adopted to consider simultaneously the effects of important "enlistment supply" factors such as economic conditions, and "demand" factors related to the incentives and behavior of Army recruiters. We then extend the basic model to represent contemporaneous and lagged effects of advertising. Finally, we describe the empirical estimates obtained by applying the model to our advertising data.

MODELING ENLISTMENT SUPPLY AND RECRUITER BEHAVIOR

Following previous research, we assume that the supply of high-quality enlistments within an MEPS is determined by the number of low-quality enlistments, local economic factors, recruiting resource expenditures, and the level of effort expended by recruiters.¹ In particular, we specify enlistment supply as

$$\log(H_t) = \beta_1 \log(L_t) + \beta_2 X_t + \beta_3 \log(A_t) + \log(E_t) , \quad (1)$$

where H_t is the number of high-quality recruits signing an enlistment contract at time t , L_t is the number of low-quality recruits, X_t represents local supply factors, A_t denotes advertising intensity for different media, and E_t represents an index of the level of effort expended by recruiters in an area.

The exogenous supply factors include estimates of the local unemployment rate computed from state-level *Current Population Survey* data, civilian wage estimates for workers in manufacturing industries within the MEPS, and the number of active Army recruiters. In addition, dichotomous indicator variables were included to control for two experimental bonus programs that were offered in two sets of areas representing about 15 percent of the nation each. The first provided an \$8,000 bonus for four-year enlistments into certain occupational

¹This modeling approach was first utilized in Polich, Dertouzos, and Press (1986).

specialties, primarily combat arms. The second program added a \$4,000 bonus for a three-year enlistment into these same specialties. In other MEPS, the standard bonus was only \$5,000 for four-year enlistments into eligible occupations.

In addition to these supply variables, the behavior of recruiters can affect enlistment outcomes. Recruiters allocate their time in response to quotas, award programs, and other incentives, thereby influencing both the quality and the quantity of people who volunteer.² Even when total effort is held constant, recruiter choices can considerably affect the mix of enlistments. For example, by cultivating contacts with high school seniors, a recruiter can secure high-quality individuals. However, spending the same amount of time in the office with "walk-ins" could result in larger numbers of total enlistments, but only at the expense of the higher-quality youths who are more difficult to recruit.

The number of low-quality enlistments is included as an explanatory variable to account for the tradeoff between categories of enlistment contracts. The supply expression (1) represents all possible combinations of high- and low-quality enlistments that are available to recruiters, holding levels of economic conditions, resource expenditures, and the magnitude (but not the direction) of total effort constant.

The mix of enlistments actually chosen by recruiters will depend on the quotas for both high- and low-quality individuals and the relative rewards for securing the different categories of enlistments. Such incentives and relative rewards are set centrally by the Army Recruiting Command and simultaneously affect all recruiters. Because the system is revised and adjusted continuously, the relative value of high-versus low-quality enlistments will be a function of quotas and monthly dummy variables representing centralized changes in management policy.³ Specifically, we assume that the optimal mix of enlistments will have the following functional form:

²On a monthly basis, recruiting areas are given quotas or missions for different categories of enlistments. These categories are based on high school education and performance on the AFQT qualifying exams. Success or failure as a recruiter depends upon the number of enlistment contracts achieved in comparison with the mission. Subsequent promotion can depend upon points accumulated on the basis of performance relative to mission. For a more detailed description and analysis of the recruiting reward and incentive system, see Dertouzos (1984, 1986).

³These quotas, incentives, and monthly command decisions do not alter the range of potential enlistment combinations and are not included in the supply expression (1). However, these "demand" factors do influence the choice of a particular enlistment outcome. Thus, reduced-form expressions for high- and low-quality enlistments will be a function of all the exogenous economic and resource variables included in the supply function as well as those factors, such as enlistment quotas, that affect recruiter behavior. For a formal characterization of this process, see Polich, Dertouzos, and Press (1986).

$$\log(H_t/L_t) = \alpha_1 \log(HQ_t) + \alpha_2 \log(LQ_t) + \sum \alpha_i M_i, \quad (2)$$

where HQ_t and LQ_t are monthly quotas for high- and low-quality recruits, respectively, and the M_i are monthly dummy variables.

Recruiters can also alter the magnitude of their effort. During the time period under study, the Army was experiencing unprecedented recruiting success. Recruiters we interviewed indicated that they were achieving their missions more readily than ever before. Under these conditions, additional changes in recruiting resource levels, such as advertising, pay, or bonuses, might not result in the full increase in enlistments that they could achieve if recruiters were fully motivated. Instead, an increase in the number of individuals potentially willing to enlist make it easier for recruiters to meet their quotas without expending the same level of effort.

To take this phenomenon into account, we have assumed that the monthly level of effort in a particular MEPS depends upon how well recruiters are performing relative to quotas.⁴ That is,

$$\log(E_t) = \gamma_1 \log(H_t/HQ_t) + \gamma_2 \log(L_t/LQ_t), \quad (3)$$

where E_t is the index of recruiter effort shown in Eq. (1), HQ_t is the high-quality quota, and LQ_t is the low-quality quota. Negative values for the coefficients imply that effort is reduced continuously as a function of the production ratios relating enlistments to quotas. Because data on actual hours and intensity of work are not available, the index E is defined relative to a baseline level of effort. That is, for some "typical" period, the index is equal to 1 and the supply expression reduces to a standard formulation because $\log(1) = 0$. Changes in effort from this benchmark are measured in units representing changes in enlistments, holding exogenous supply factors constant. A 10 percent decline in enlistments under identical supply conditions can therefore be viewed as a 10 percent reduction of recruiter effort.

For purposes of estimation, expression (3) can be substituted into the enlistment supply function (1) to remove the unobservable index of effort from the system. That is,

$$\begin{aligned} \log(H_t) = & \alpha_1 \log(L_t) + \alpha_2 X_t + \alpha_3 \log(HQ_t) \\ & + \alpha_4 \log(LQ_t) + \alpha_5 \log(A_t) + u_t, \end{aligned} \quad (4)$$

⁴Expressions (2) and (3) can be viewed as approximations to first-order conditions resulting from the maximization of recruiter utility, $U(H_t, L_t, E_t, HQ_t, LQ_t)$, subject to the supply constraint (1).

where $\alpha_1 = (\beta_1 + \gamma_2)/(1 - \gamma_1)$

$$\alpha_2 = \beta_2/(1 - \gamma_1)$$

$$\alpha_3 = -\gamma_1/(1 - \gamma_1)$$

$$\alpha_4 = -\gamma_2/(1 - \gamma_1)$$

$$\alpha_5 = \beta_3/(1 - \gamma_1)$$

MODELING THE EFFECT OF ADVERTISING EXPENDITURES

In the supply expression, A_t represents the stock of "good will" contributed by current and previous advertising expenditures for each medium. We assume that this stock of advertising for each medium is a distributed (Koyck) lag function of current and past advertising expenditures, the effects of which are depreciating at a geometric rate, ρ . We assume that this depreciation rate is the same for all media.⁵ So,

$$\begin{aligned} \log(A_t) = & \log(a_t) + \rho \log(a_{t-1}) + \rho^2 \log(a_{t-2}) \dots \\ & + \rho^n \log(a_{t-n}) \dots \end{aligned} \quad (5)$$

Of course, because the expression for A_t contains an infinite series of expenditures, Eq. 4) cannot be directly estimated without imposing some assumptions about the value of ρ .

As an alternative, multiplying (5) by ρ , lagging one month, and subtracting yields:

$$\log(A_t) - \rho \log(A_{t-1}) = \log(a_t) - \rho^{n+1} \log(a_{t-n}) \quad (6)$$

For values of $\rho < 1$, ρ^{n+1} converges to zero for a sufficiently large n . That is, the effect of advertising diminishes over time so that current

⁵The specification of multiple decay rates, though theoretically straightforward to specify, presents extreme numerical problems in estimation. First, the error structure will follow a moving average process of the same order as the number of decay parameters. Second, maximum likelihood estimation of multiple decay parameters is extremely unstable, either failing to converge or coming to rest on explosive (nonpositive) decay parameters.

enlistments are negligibly affected by advertising expenditures in the distant past. Therefore,

$$\log(A_t) - \rho \log(A_{t-1}) = \log(a_t) . \quad (7)$$

Now, performing the same transformation on (4) and substituting for $(A_t - \rho A_{t-1})$ yields:

$$\begin{aligned} \log(H_t) - \rho \log(H_{t-1}) & \\ + \alpha_1[\log(L_t) - \rho \log(L_{t-1})] & \\ + \alpha_2[X_t - \rho X_{t-1}] & \\ + \alpha_3[\log(HQ_t) - \rho \log(HQ_{t-1})] & \\ + \alpha_4[\log(LQ_t) - \rho \log(LQ_{t-1})] & \\ + \alpha_5 \log(a_t) + e_t & \end{aligned} \quad (8)$$

We know that in its present form, expression (8) should not be directly estimated because the transformation induces a first order moving average structure in the error; i.e., $e_t = u_t - \rho u_{t-1}$. The autocorrelation of the observed error will be $e_t = \lambda e_{t-1} + v_t$ where

$$\lambda = \frac{-\rho}{1 + \rho^2} .$$

This holds if the only source of correlation is the Koyck transformation and the original error terms, u_t , remain uncorrelated and independently distributed.⁶

It is well known that direct estimation of (8), because of correlations between the e_t and lagged dependent variables H_{t-1} and L_{t-1} , will lead to biased estimates. However, a second transformation purges the

⁶For a derivation of the autocorrelation function of a first-order moving average, MA(1) process, see Box and Jenkins (1976).

remaining residue of the autocorrelation. Multiplying (8) by λ , lagging an additional period, and subtracting the resulting expression yields:

$$\begin{aligned}
 \log(H_t) - (\lambda + \rho)\log(H_{t-1}) - \lambda\rho\log(H_{t-2}) \\
 + \alpha_1[\log(L_t) - (\lambda + \rho)\log(L_{t-1}) + \lambda\rho\log(L_{t-2})] \\
 + \alpha_2[X_t - (\lambda + \rho)X_{t-1} + \lambda\rho X_{t-2}] \\
 + \alpha_3[\log(HQ_t) - (\lambda + \rho)\log(HQ_{t-1}) + \lambda\rho\log(HQ_{t-2})] \\
 + \alpha_4[\log(LQ_t) - (\lambda + \rho)\log(LQ_{t-1}) + \lambda\rho\log(LQ_{t-2})] \\
 + \alpha_5[\log(a_t) - \lambda\log(a_{t-1})] + v_t, \quad (9)
 \end{aligned}$$

where $\alpha_1 = (\beta_1 + \gamma_2)/(1 - \gamma_1)$

$$\alpha_2 = \beta_2/(1 - \gamma_1)$$

$$\alpha_3 = -\gamma_1/(1 - \gamma_1)$$

$$\alpha_4 = -\gamma_2/(1 - \gamma_1)$$

$$\alpha_5 = \beta_3/(1 - \gamma_1)$$

and v_t represents residual errors that, because of the transformation, are uncorrelated and independently distributed.

EMPIRICAL RESULTS

Using a nonlinear, three-stage least-squares methodology, we jointly estimated Eqs. (9) and (2). This procedure provides consistent estimates for all the underlying structural parameters representing recruiter behavior, general supply relationships, and advertising effects.⁷

⁷Since low-quality recruits are also endogenous, simultaneous equation methods were necessary. The estimation routine was the SAS procedure SYSNLIN. The iterated 3SLS is a limited information maximum likelihood method that uses the Gauss-Newton maximization algorithm. Consistent starting values are necessary for consistent estimation; these came from 2SLS methods. A grid search was performed around the final estimates to provide assurance that a global maximum was found.

The model was estimated in first-difference form for several reasons. Previous analysis of these data examined year-to-year changes in the context of a controlled experiment assessing changes in enlistment bonuses. This model provided robust and extremely plausible parameter estimates. Given the strength of our priors, we wished to avoid tenuous specification searches and straightforwardly generalized the previous model, thereby maintaining the integrity of hypothesis tests on advertising variables that were not previously examined. In addition, the use of a change model netted out fixed effects for individual MEPS and dramatically reduced the number of model parameters. Finally, year-to-year differences considerably reduced the collinearity between explanatory variables. Alternative transformations were not quite so effective.⁸

Effects of General Supply and Demand Factors

Tables 4 and 5 present sample means and coefficient estimates for general supply and demand factors. For the most part, the estimated effects of supply and recruiter behavior factors are not qualitatively

Table 4

MEANS AND STANDARD DEVIATIONS OF CONTROL VARIABLES^a

Variable Name	Mean	Standard Deviation
High-quality contracts	71.0	49.3
Low-quality contracts	78.9	55.5
Unemployment rate (percent)	8.85	2.30
Civilian wage rate (hourly)	8.62	1.19
Number of recruiters	73.8	48.3
High-quality quota	64.0	44.5
Low-quality quota	72.5	48.8

^aBased on 2376 monthly observations (66 MEPS areas, each measured during 36 months).

⁸Brown (1985) demonstrates the importance of netting out fixed effects in estimations of enlistment models. Deviating each variable from its cross-sectional mean eliminates the need to estimate separate dummy variables for each area. However, the annual differencing employed in this work eliminates fixed effects and also addresses the possibility of nonstationarity in the time series data. A grouped F-test rejected the specification of additional fixed MEPS effects in changes (after differencing). Tests for autocorrelation in the estimated residuals detected no remaining seasonality.

Table 5

HIGH-QUALITY ENLISTMENT EFFECTS: CONTROLS
FOR SUPPLY AND DEMAND

Elasticity of High-Quality Recruits with Respect to	Coefficient	Standard Error	t
Low-quality enlistments	-.133	.051	-2.59
Unemployment rate	.512	.107	4.76
Civilian wage rate	.333	.426	0.77
Number of recruiters	.542	.064	8.46
Bonus programs			
8K, 4-yr only	.008	.033	0.24
8K/4K, 4-yr/3-yr	.048	.034	1.43
High-quality quota	.134	.055	2.44
Low-quality quota	-.066	.038	-1.75

different from those reported in previous research.⁹ For example, unemployment rates and numbers of recruiters have significant and positive effects on high-quality contracts. The estimated effects of bonuses and civilian wages were less precise and the large standard errors preclude making any conclusions. The coefficient on low-quality enlistments was .133, suggesting that, when evaluated at the sample means, recruiters can substitute about eight low-quality for every one high-quality enlistment. In addition, increases in high-quality quotas increase high-quality enlistment. This suggests that recruiter effort will increase about 1.2 percent following a 10-percent quota increase.¹⁰ However, the coefficient on low-quality quotas has a negative but imprecisely estimated effect.

Advertising Elasticities

Table 6 provides elasticity estimates for advertising expenditures. For national advertising, all media appear to increase enlistment supply substantially. For example, a 100 percent increase in television advertising can be expected to increase high-quality enlistments by 2.31 percent in the current period. The enlistment increases as a result of

⁹Although not qualitatively or statistically different from results reported in Polich, Dertouzos, and Press (1986), coefficient estimates were generally smaller and, occasionally, less significant. These minor divergences appear to be the result of the additional transformations and the attendant loss of observations.

¹⁰Recall that the underlying elasticity of effort (E) with respect to the high-quality quota ($-\gamma$) can be derived from the elasticity of high-quality enlistments with respect to the quota (α_3) since $\alpha_3 = -\gamma_1/(1 - \gamma_1)$.

Table 6

ADVERTISING EFFECTIVENESS: HIGH-QUALITY
ELASTICITY ESTIMATES

Variable	Coefficient	Standard Error	t
Local Advertising			
Daily newspapers	.0051	.0021	2.38
Weekly newspapers	.0029	.0020	1.49
Local radio	.0000	.0021	0.00
High school newspapers	-.0011	.0026	-0.44
National advertising			
Network radio	.0085	.0018	4.65
Television	.0231	.0044	5.29
Magazine	.0218	.0058	3.80
Depreciation rate	.5751	.0257	22.35

doubling national radio and magazine advertising budgets would be .85 and 2.18 percent, respectively.

For local advertising, the effects are mixed. On one hand, increases in expenditures on daily newspaper advertising are significantly related to high-quality enlistment. A 100 percent rise in the local ad budget allocated to this medium results in a .5 percent increase in high-quality recruits. The elasticity for expenditures on secondary or weekly newspapers was smaller and not quite significantly different from zero at the 90 percent level. On the other hand, neither high school expenditures nor local radio purchases had any discernible effect on enlistments. This result is somewhat disturbing since more than half of the local advertising budget is allocated to radio spots, on average.¹¹

The estimate of ρ , the coefficient on lagged high-quality enlistments, indicates a depreciation rate of .58. That is, advertising has effects that persist into the future.¹² For example, doubling the national

¹¹The contrast between local and national radio effectiveness could well be the result of the superior audience reach per unit cost that is achievable when media purchases are made centrally. The distinction could be due to a superior within-medium buying pattern, the relative size of the local ad budget, or systematic differences in audience demographics or the creative content of radio spots.

¹²This depreciation rate would induce an autoregressive term of $-.43$ in the absence of any other source of autocorrelation $(-.58/(1 + .58 \times .58))$. See Box and Jenkins (1976). In fact, this term was estimated from expression (9) to be $-.39$ with a standard error of .03, suggesting that the Koyck-lag structure is a fair empirical representation of the process.

magazine advertising budget for one month would result in an immediate 2.18 percent rise in potential high-quality enlistments; this effect will carry forward to the next month, though depreciating by 42 percent. Thus, enlistments will continue to be higher, by $.58 \times 2.18$, in the next month, even if advertising returns to the original level. By the sixth month, the effect of advertising will have diminished to about 4 percent of the original effect. Although these effects diminish rapidly, the sum of future changes in enlistments amounts to about 1.4 times the simultaneous enlistment effect. Thus, the long-run elasticities are about 2.4 times as large as the short-run elasticities reported in Table 6.¹³

For purposes of comparison, the short-run elasticities were evaluated at the mean sample values, producing the marginal cost estimates and two-standard-deviation ranges reported in Table 7. Advertising expenditures are effective marketing mechanisms, even when we ignore the cumulative long-run effects. Generally speaking, the print media appear to be more cost effective advertising outlets. In particular, magazine advertising is superior to other forms of national advertising, at least within the range of actual budget levels. Although the point estimate for weekly newspaper purchases is somewhat lower, the wide

Table 7

MARGINAL ADVERTISING COSTS OF OBTAINING HIGH-QUALITY
ENLISTMENTS WITHIN ONE MONTH

	Point Estimate	Confidence Interval (Two standard deviations)
Local advertising		
Daily newspapers	\$ 3,380	\$1,060-5,410
Weekly newspapers	\$ 1,680	\$ 720-infinite
Local radio	infinite	\$8,470-infinite
High school newspapers	infinite	\$1,030-infinite
National advertising		
Network radio	\$ 7,280	\$5,080-12,850
Television	\$10,120	\$7,345-16,270
Magazine	\$ 1,980	\$1,290-4,200

¹³In general, these advertising estimates were extremely robust with respect to alternative model specifications and estimation methodologies. The untransformed version of expression (9) was estimated using instrumental variable techniques with lagged values of exogenous variables serving as instruments. The estimates of the depreciation rate and the relative effects of advertising alternatives were invariably similar.

standard error of the elasticity estimate cautions strongly against policy conclusions concerning weekly newspapers.

Daily newspapers are clearly more effective than local radio purchases. We can be reasonably confident that the marginal cost of a short-term enlistment contract through daily newspaper advertising falls between \$1,060 and \$5,410. In contrast, the marginal cost of a recruit through local radio advertising is greater than \$8,000, strongly suggesting that local advertising managers should carefully consider altering the current mix of media purchases.

These short-run marginal costs compare quite favorably with estimated costs of obtaining high-quality enlistments by alternative resource expenditures. For example, the estimated elasticity of high-quality recruits with respect to recruiters was .542. Evaluated at the sample means, this implies that a 2.6 percent increase in the average recruiting force of 73.8 would be necessary to attract one additional high-quality recruit (a 1.4 percent increase from 71 to 72). Ignoring notions of opportunity cost and the source of these extra recruiters, we can assume that the average monthly compensation of \$3,000 represents the added monthly expenditures per recruiter. This implies a marginal cost of under \$6,000 per high-quality recruit. In addition, enlistment bonuses can increase high-quality enlistments for a marginal cost of \$16,000.¹⁴ In terms of short-run effectiveness, advertising programs belong in the resource portfolio of Army recruiting managers.

¹⁴See Polich, Dertouzos, and Press (1986) for a detailed discussion of these alternative cost estimates.

V. CONCLUSIONS

The utility of advertising expenditures may well go far beyond the short-run objectives of increasing the immediate supply of high-quality Army enlistments. An effective advertising campaign could have far-reaching effects on political attitudes, inspire high levels of service morale, greatly influence retention or attrition behavior, and slowly cultivate public attitudes that have important but unmeasurable effects on future enlistments. Our research does not directly consider these potential benefits, which may, in fact, be impossible to document. Thus, even in the absence of any measurable enlistment effects, we would remain reluctant to draw broad conclusions concerning the relative efficiency of advertising versus alternative resource expenditures.

If we set these broader issues aside, our research strongly supports the conclusion that advertising expenditures substantially affect short-run enlistment behavior. In general, we have found that an expansion of the Army advertising program during a given month can induce increases in high-quality contracts for as long as six months. Indeed, calculations of implied marginal costs of accessions suggest that national and local advertising compare quite favorably with alternative policy instruments such as recruiter resources, bonuses, and salary compensation.

In addition, we have found that the effectiveness of the advertising budget depends on the pattern of media buys. Statistical results indicate that national magazine and local newspaper purchases are the most effective in promoting enlistments. National radio and network television also have considerable effects. Over the range of the sample, however, electronic media appear to be somewhat less effective than print alternatives. At the other extreme, local radio has no measurable effect on short-run enlistments. Given the importance of radio in the local advertising budget, some reevaluation of local advertising policy would be prudent. For other forms of local advertising such as high school newspapers, weekly publications, and nonstandard media, estimated coefficients were not significantly different from zero. In contrast to local radio, however, the computed confidence intervals were too wide to come to any reasonable policy conclusions.

Although these empirical results appear to be extremely robust with respect to alternative model specifications, several caveats remain in order. To begin with, the elasticity estimates remain valid only over the limited range of the data. Thus, projections based on dramatic

reallocations of the advertising budget are not likely to be reliable. These results may also depend on the creative content of the advertising. In addition, several plausible generalizations of the model were not pursued at length. Preliminary efforts to consider complex interactions between advertising categories and other resource expenditures or different lagged effects by media type were not successful. It is our view that, given the current level of complexity embedded in the enlistment model, future research in these directions will probably not be worth the effort.

Our research was not designed to address an important issue that appears worthy of further investigation. In this study, we exclusively examine Army enlistments and advertising expenditures. This perspective is useful for managing the Army advertising budget, but it fails to consider issues of broader policy importance. It is not clear whether increased Army enlistments represent a pure market expansion or, instead, come at the expense of the Navy, Air Force, or Marine Corps. From a DoD point of view, this distinction could be critical in evaluating the relative efficiency of Army-specific media expenditures compared with other military advertising or recruiting resource alternatives.

Appendix

LOCAL ADVERTISING DATA

To support the analysis described in this report, we obtained detailed datasets summarizing Army national and local advertising from N. W. Ayer, the Army's advertising agency. The national advertising data consisted of reports of expenditures (by medium by month) and estimates of the number of impressions (by Area of Dominant Influence by medium by month). The impressions estimates for national advertising were produced by N. W. Ayer using standard industry methods.¹ To allocate national advertising expenditures to local areas, we divided the monthly total nationwide expenditure for each medium among areas in proportion to the number of impressions that each area received through that medium.

For local advertising, however, there were no standard databases to report costs or to estimate impressions by medium. Because one of our principal interests was the relative effectiveness of specific media for both local and national advertising, we constructed the necessary datasets to assess local advertising costs and audiences. This appendix describes the two main types of information collected:

1. *Local advertising purchase data*, including records of all advertising purchased by local Army recruiting battalions;
2. *Local media audience data*, showing the size of the audience for each vendor who sold local advertising to the Army.

DATA ON PURCHASES

To identify the specific media used in each area and the timing of the advertising delivery, we obtained a record of each Army local advertising purchase for the period from July 1981 through June 1984. These purchases were generally negotiated by the Army's local representative directly with a vendor (such as a radio station,

¹An impression is defined as one exposure of one individual to one ad. Industry estimation methods identify the set of individual broadcast stations and print media that carried each national ad during each month and then calculate the total number of persons exposed to the ad based on surveys of the population's reading, listening, and viewing habits.

newspaper, state network of radio stations, or group of newspapers), and they normally specified details such as dates of performance, cost, and the number of spots for radio or the number of insertions for newspapers. Approximately 80,000 such purchase orders were issued for the study period.

Many local purchases were made directly from individual commercial newspapers and high school newspapers. In addition, a large amount of newspaper advertising was bought through "groups," or aggregates of related newspapers whose space is marketed together. For example, ads in a set of suburban weekly newspapers serving different communities may be sold by one publisher or representative. We identified the location and circulation of all of the constituent papers within such groups and allocated the cost and other parameters among the individual papers in proportion to their advertising line rates.²

Radio ads, for the most part, were placed directly with local radio stations, though occasionally they were arranged through regional or state networks. Mostly these ads consisted of audio tapes of spots produced by N. W. Ayer's headquarters, but some battalions wrote their own scripts and had them recorded or read by station announcers.

The battalions also used various other "nonstandard" media to reach special audiences. Nonstandard media included insertions in school sports programs, exhibits at conventions and career days, outdoor advertising, and similar media whose audiences are difficult or impossible to determine. During the time period covered, such media represented about 20 percent of local expenditures. We did not attempt to rate these media.

For each ad buy, our purchase dataset included the Army recruiting battalion, the cost, and the period during which the advertising ran. In addition, for newspaper and radio ads, the data included an identifier for the specific vendor and the frequency during each month of the study period (for newspapers, number of issues in which insertions were made; for radio, number of spot announcements). This purchase dataset was aggregated by battalion and then transformed, producing expenditure totals by MEPS area by month; and it was further combined with audience data, as described below, to provide estimates of impressions.

²We used the following sources to identify both individual newspapers and members of groups: (1) *Circulation '83/'84*, which lists all daily newspapers in the United States; (2) *N. W. Ayer '83 Directory of Publications*, an encyclopedic reference that identifies most important general-circulation newspapers and many specialized publications; (3) the *1984 National Directory of Weekly Newspapers*, which covers many papers not listed in the Ayer Directory; and (4) the *1983 Editor and Publisher International Yearbook*, which links publishing companies to names of newspapers.

DATA ON AUDIENCES

At the outset of the research, we were concerned that expenditures might not be translated into impressions in a uniform fashion across areas, and that knowledge of the number of impressions could be important in making accurate estimates of advertising effects. To test this notion required data showing the size of the group reached by each advertising vendor.

Commercial Newspapers

Data on the circulation of daily commercial newspapers are compiled by the Audit Bureau of Circulations, which prepares a certified count of the number of copies distributed by its member newspapers. We obtained data from ABC showing the circulation of most major newspapers in the nation. For the small number of non-ABC daily newspapers, we obtained estimated circulation (based largely on publishers' statements) from American Newspaper Markets. These datasets permit disaggregation of circulation by county, in the case of newspapers that circulate in more than one county.

There are, of course, many smaller newspapers that publish less frequently than daily. These "secondary" newspapers accounted for about 20 percent of all commercial newspaper purchase orders. For each such newspaper that was bought by an Army battalion, we obtained circulation figures from industry reference works or in some cases by direct contact with the publisher. Typically, these data sources did not break down circulation of such papers by county; we simply assumed that the circulation of a given secondary newspaper occurred within the county in which it was located. We believe this is a reasonable assumption for the great majority of such papers, whose circulation is usually less than five thousand.

School Newspapers

School newspapers represent about 25 percent of the local advertising purchase orders issued by the Army. Even though the expenditures involved are modest, the large number of orders prompted us to seek a measure that would represent the size of the audience. Because there is no central repository of information about the circulation of high school newspapers, we decided to use, as a proxy for circulation, the number of seniors enrolled. Although total enrollment obviously overstates the number of newspaper copies in circulation, it is reasonable to

assume that the overstatement does not systematically vary across areas or over time.³

To determine enrollments we relied primarily on survey data on public and private high schools from the U.S. Department of Education's Center for Statistics. Because the high school survey responses were substantially incomplete for certain states, we also obtained a backup file of high schools collected by Army recruiters and archived by the Defense Manpower Data Center. Together, these files enabled us to estimate the relevant enrollment parameters for about 95 percent of high schools.

Radio

The principal sources of audience data for the broadcast media are the ratings services. Both A. C. Nielsen and the Arbitron Ratings Company compile ratings for individual stations, based on periodic sample surveys of the general population.⁴ Because Arbitron data cover more stations than Nielsen with greater geographic detail (estimates by county), we acquired the Arbitron national database for 1982. It gives estimates of the cumulative number of listeners (for a weekly period) for each station in the country.

Estimation of Impressions

The total number of impressions resulting from running an ad in a given area is the product of (1) the number of occasions on which the ad is run and (2) the number of individuals who are exposed to the ad. To calculate impressions, we therefore associated each ad purchase record with the particular vendor that carried the ad and performed the requisite calculations. For example, if a newspaper ad ran five times during a given month and the newspaper's circulation in a given area was 50,000, the estimated number of impressions for that area was 250,000 during that month. Similarly, if a radio spot announcement ran 10 times during the month and the station had an average audience of 20,000, the estimated number of impressions was 200,000. After these calculations were made for each ad purchase, the resulting impressions estimates were summed across ads and vendors within counties and across counties within MEPS areas, to yield the total number of impressions for a given media type in a particular MEPS area and month.

³Biases such as this overstatement will not affect results in a difference model, such as the one used in our analysis.

⁴The most common data collection method, used by Arbitron, is to select a sample of people and recruit them to keep an hourly diary of radio listening for a week or more.

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